2005 HSC Notes from the Marking Centre Chemistry

Published by Board of Studies NSW
GPO Box 5300
Sydney 2002
Australia

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Fax: (02) 9367 8484

Internet: http://www.boardofstudies.nsw.edu.au

ISBN 1741473713

2006065

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2005 HSC NOTES FROM THE MARKING CENTRE CHEMISTRY

Introduction

This document has been produced for the teachers and candidates of the Stage 6 course in Chemistry. It provides comments with regard to responses to the 2005 Higher School Certificate examination, indicating the quality of candidate responses and highlighting the relative strengths and weaknesses of the candidature in each section and each question.

This document should be read along with the relevant syllabus, the 2005 Higher School Certificate examination, the marking guidelines and other support documents which have been developed by the Board of Studies to assist in the teaching and learning of Chemistry.

General Comments

In 2005, 10 083 candidates attempted the Chemistry examination. The most popular electives were Shipwrecks, Corrosion and Conservation (47%) and Industrial Chemistry (36%).

Teachers and candidates should be aware that examiners may write questions that address the syllabus outcomes in a manner that requires candidates to respond by integrating their knowledge, understanding and skills developed through studying the course, including the Prescribed Focus Areas. This reflects the fact that the knowledge, understanding and skills developed through the study of discrete sections should accumulate to a more comprehensive understanding than may be described in each section separately. It is important to understand that the Preliminary HSC course is assumed knowledge for the HSC course.

In 2005, at least one question in Section 1 Part B focused on the skills content in Module 9.1. Candidates who had actively planned and performed practical experiences clearly demonstrated a deeper knowledge and understanding of the content described in this module. In addition, there was clear evidence that many candidates had not performed the first-hand investigations. These are a crucial part of the syllabus and are examined. The knowledge gained from these experiences underpins the development of knowledge in Chemistry. In undertaking investigations involving secondary sources, candidates should check a variety of sources for reliability and accuracy of content, rather than rely heavily on one source.

Overall, the candidate's responses were appropriate and indicated a level of understanding of chemistry concepts appropriate for most HSC candidates. There was evidence that some candidates had a very poor knowledge of basic definitions specific to terminology associated with chemistry. This includes the writing of balanced equations, including states of matter, the mole concept and any calculations associated with it.

Candidates need to be reminded that the answer space provided and the marks allocated are guides to the maximum length of response required. Similarly, the key word used in the question gives an indication of the depth of the required response. Candidates should use examination time to analyse the question and plan responses carefully, working within that framework to produce clear and concise responses. This is particularly so in holistic questions which need to be logical and well structured. The use of dot points, diagrams and/or tables may be used to demonstrate their deeper level of understanding in Chemistry and avoid internal contradictions.

Better responses indicated that candidates are following the instructions provided on the examination paper. In these responses, candidates:

- show all working for numerical questions and express their answers with the correct number of significant figures
- think carefully about the units to be used and the quantities to be substituted into formulae.
- do not repeat the question as part of the response
- look at the structure of the whole question and note that in some questions the parts follow from each other ie responses in part (a) lead to the required response in part (b) etc
- use appropriate equipment, for example, pencils and a ruler to draw diagrams and graphs. (A clear plastic ruler would aid candidates to plot points that are further from the axes and rule straight lines of best fit.)

The option question is divided into a number of parts: candidates should clearly label each part of the question when writing in their answer booklets. In part ©, many candidates wrote a lot of information that was not relevant to the question. Some responses show evidence of rote learning an anticipated answer based on a single source. These did not address the syllabus content and/or outcomes being assessed and hence did not score full marks. Some candidates are responding to more than one option question: candidates are strongly advised to answer the option they have studied in class.

Section I – Core

Part A – Multiple choice

Question	Correct Response
1	B
2	C
3	B
4	D
5	B
6	A
7	C
8	A

Question	Correct Response
9	D
10	C
11	A
12	B
13	C
14	D
15	A

Part B

Specific Comments

Question 16

(a) The majority of responses correctly named an appropriate alkene.
Weaker responses named a gaseous alkene.

(b) Responses that successfully linked the identified hazard and how it was addressed scored well. Responses that scored poorly did not identify a specific hazard for the first hand investigation and/or used vague or generic terms to outline how to address the hazard.

(c) ©Better responses indicated the key elements of a safe, experimental procedure and identified appropriate reactants for this investigation. Weaker responses incorrectly included results and presented contradictory data.

Question 17

(d) The majority of responses stated an appropriate reason for this difference.

(e) Better responses clearly set out all relevant working and left the rounding off until the last step.

Question 18

Most responses were able to identify impacts of a biopolymer. Better responses indicated that candidates had gathered information from secondary sources about recent developments of a named biopolymer and included a judgement about its impacts. There was evidence that these responses were structured to include only the relevant information required by the question.
Weaker responses could not distinguish between a polymer and a biopolymer.

Question 19

(f) Candidates are reminded that their answer should identify a specific impact rather than offer a general statement, such as 'the chemicals harm the environment'.

(b) Better responses included balanced half equations or an overall equation and included identification of the anode, cathode and electrolyte.

Question 20

Better responses included balanced chemical equations and gave details about the reactants, products and conditions. They included labelled diagrams of appropriate laboratory equipment.

Question 21

Better responses showed a clear understanding of the chronological development of knowledge of acid-base theory and drew out and related the implications of each development. They used precise terms with respect to ions, atoms and molecules.

Question 22

(a) Better responses identified the independent and dependent variables and labelled the axes correctly. They ensured that axes had linear scales that used the extent of the grid provided. Most candidates plotted the points correctly by marking the point with a cross or a circle. The better candidates used a pencil and ruler to draw two lines of best fit that intersected at a point and left out the outlier point from the line of best fit.

(b) Most candidates identified the correct volume; however, many did not use the correct unit for volume, milliliter (mL), although it was indicated in the table. The better responses identified that hydrochloric acid (HCl) was the limiting reagent.

(c) The better responses included the correct balanced equation, all the steps in their working, correct information from the data sheet and correct volume with correct units. They calculated the number of moles of zinc and used the correct number of significant figures.

Question 23

(g) This part of the question was well answered. Most candidates were able to state that incomplete combustion results when there is a lack of oxygen.

(h) This part of the question was poorly answered. Better responses included a balanced equation for the incomplete combustion of methane with correct states for each reactant and product. Weaker responses did not identify the products of incomplete combustion or gave an equation for the complete combustion of methane.

Question 24

(a) This part of the question was extremely poorly answered by the majority of candidates, with the most common errors being the failure to include states, and recognition that carbon dioxide, water and an aqueous salt were formed.

(b) Better responses accurately calculated the number of moles of acid.

(c) Better responses calculated the moles of excess hydrochloric acid neutralised by the sodium hydroxide, then went on to calculate the mass of calcium carbonate.

Question 25

(a) The better responses were able to clearly use the data to calculate the percentage of total dissolved solids. A significant number of candidates were unable to distinguish between the insoluble solids and the TDS.

(b) The better responses described a distinguishing chemical test to identify lead (eg precipitation) and supported it with a correct chemical equation.

(c) Generally well answered.

Question 26

Most responses described the processes involved in purifying the contaminated water. Better responses generally identified, described and made a judgement about each step of the process often using five to seven steps.

Question 27

(a) Generally well answered.

(b) (i) The better responses were able to show the initial spikes of increased concentration, the correct changes to each species concentration and the re-establishment of equilibrium. The majority of candidates did not include the initial spikes.

(ii) The better responses were able to link the reduction in volume to an increase in pressure and use Le Chatelier's Principle to explain the shift to the side with least moles of gas.

Section II – Options

Question 28 – Industrial Chemistry

(a) (i) Most candidates correctly identified oleum.

(ii) Better candidates clearly linked the chemical properties of both dilute and concentrated sulfuric acid to transport safety requirements. Weaker responses included very general safety requirements such as the use of gloves, goggles etc which did not relate to the transport issues.

(b) (i) Better responses gave reasons in terms of the molar ratio of gas volume for the effects of the increase in pressure on the yield of dinitrogen tetroxide, and indicated that the addition of a catalyst would not affect the yield.

(ii) Better responses correctly determined the equilibrium concentrations of each species, and then substituted correctly into the equilibrium expression. They also accounted for the change in the equilibrium constant in terms of the exothermic nature of the forward reaction. Weaker responses did not include a correct equilibrium expression as part of their working.

(c) Better responses included the advantages and disadvantages of the three methods of sodium hydroxide (NaOH) production, as well as descriptions of the changes in chemical processes that have occurred. These responses also included relevant chemical equations. Weaker responses were able to provide good descriptions of the advantages and disadvantages, but were limited in their understanding of the chemistry involved in the processes.

(d) (i) Most candidates were able to correctly identified the compound as sodium carbonate.

(ii) Better candidates went beyond simply processing information from the diagram and gave a clear overview, with relevant equations, of the chemistry of the ammonia recovery. Many candidates with poorer understanding of the chemistry confused reactions and gave incorrect reactants.

(iii) Better responses identified at least three chemical issues from the process, namely excess calcium chloride, thermal pollution and ammonia leakage and made judgements about the effectiveness of the treatment methods identified. Weaker responses outlined problems without linking to the Solvay process specifically, for example noise, dust, and quarrying.

Question 29 – Shipwrecks, Corrosion and Conservation

(a) (i) This question was generally well answered.

(ii) The better responses compared the same property for both named steels. Properties and uses had to be consistent with the type of steel. The more concise answers were presented in a table.

(b) (i) The majority of candidates sketched in general terms the effect of one factor such as lower oxygen concentrations, lower temperature and the presence of anaerobic bacteria on the rate of corrosion.

(ii) Very few candidates provided characteristics and features of the different chemical processes occurring in the beaker. The better responses gave detailed observations of the displacement reaction occurring on the magnesium strip and the corrosion processes occurring on the iron nail and included chemical equations when describing an experiment.

(c) Better responses described at least three corrosion protection technologies including both cathodic protection and physical barriers, relating the technology to advances in chemistry, outlined advantages and disadvantages of each technology or advance, and supported their answer with chemical equations.

(d) (i) This question was well answered.

(ii) Most candidates addressed the purpose of placing the cannon in dilute sodium hydroxide.

(iii) Better responses were carefully constructed and provided features and characteristics of the procedure, detailing the processes occurring at the anode and cathode. A labelled diagram and correct equations made their answers succinct. A significant number were able to justify either why electrolysis was used or particular processes occurring at the anode and cathode.

Question 30 – Biochemistry of Movement

(a) (i) Better responses indicated an understanding of chemical structures, for example correctly drawing the covalent bonds of the oxygen of the hydroxyl group.

(ii) Most candidates had a basic understanding of bonding within an alkanol with most recognising the importance of the role of hydroxyl groups in polarity and thus solubility in water or their importance in hydrogen bonding and thus viscosity. Few candidates were able to link the hydroxyl groups to hydrogen bonding and therefore to both viscosity and solubility.

(b) (i) The majority of candidates were able to quantify the amount of adenosine triphosphate (ATP) produced by both processes.

(ii) Most candidates showed knowledge of oxidation and reduction in terms of the loss and gain of electrons and that NADH and $FADH_2$ played a role in respiration. Better responses demonstrated an in-depth knowledge of glycolysis, the tricarboxylic acid cycle and oxidative phosphorylation and outlined precisely the role of NADH and

$FADH_2$. These responses linked the role of NAD^+/NADH and FAD/$FADH_2$ to the production of ATP.

(c) Better responses demonstrated knowledge of both protein structure and shape (primary, secondary, tertiary and quaternary) and the current model of enzyme function, ie the lock and key model. They provided evidence of a relationship between chemical features and the structure and shape and included the judgement necessary in the answer.

Most candidates showed knowledge of the lock and key model of enzymic function but were unable to show how this model was reliant on the specificity of shape of the active site on the enzyme. The better candidates were able to show how the shape could be changed through denaturation by pH change or temperature change. Very few candidates included bonding formed at the active site.

(d) (i) The majority of candidates showed an understanding of the components of carbohydrates being carbon, oxygen and hydrogen. Better responses provided the general formula for carbohydrates as $C_x(H_2O)_y$.

(ii) The majority of candidates were aware that carbohydrates were stored as glycogen. Better responses demonstrated knowledge of the process by which carbohydrates are stored, in particular the condensation reaction that needs to take place between the glucose monomers in order to make glycogen.

(iii) The majority of candidates were able to draw information from the table to say that both the sports drinks contained carbohydrates and were needed for energy and make a judgement about the hypothesis. Better responses correctly discussed the metabolic processes occurring with the sprinter. They understood the immediate need to replace the used up ATP by the breakdown of creatine phosphate and not carbohydrates. Since neither of the sports drinks contain creatine phosphate they will not provide energy to sprinting athletes.

The majority of candidates were able to articulate the metabolic processes occurring with the marathon runner. The major error in this section was that most candidates had no idea about the time frame within which the metabolic process takes place and assumed that glucose would immediately produce energy once it had been drunk, in the form of the sports drinks.

Question 31 – Chemistry of Art

(a) (i) This question was poorly done. There is evidence that candidates have not had first-hand experience of the use of potassium permanganate as a strong oxidising agent.

(ii) Better responses demonstrated appropriate use of the Data Sheet. They stated reasons for oxidation state changes for both metals and linked the reactions.

(b) (i) Better responses indicated precise relationships between different metals, different oxidation states, different ligands and different colours.

(ii) Candidates generally had a good knowledge of the use and importance of pigments in different ancient cultures.

(i) Many candidates could outline how laser microspectral analysis works; better responses gave a good explanation with clear reference to vaporisation and excitement of the vapour. They included the main features of emission spectrum formation and provided a judgement on the types of technologies used.

(d) (i) Most candidates have good knowledge of the Pauli Exclusion Principle.

(ii) Most candidates identified the difference between first ionisation energy and electronegativity.

(iii) Better responses referred to effective nuclear charge, and could explain the anomalies for boron and oxygen with reference to the sub-shells.

Question 32 – Forensic Chemistry

(a) (i) The majority of candidates correctly identified the elements.

(ii) Most candidates demonstrated some understanding of emission spectra. Better responses included a labelled diagram to describe the emission.

(b) (i) Most candidates could identify only 1 or 2 of the three labelled components. A significant number of candidates confused deoxyribose sugar and the phosphate groups.

(ii) Better responses clearly identified the types of DNA segments that are used for comparison between individuals and had a good understanding of introns and related these to similarities among individuals.

(iii) Better responses clearly identified issues relating to DNA data banks and provided specific detail of practices that were positive and negative for maintaining DNA databanks.

(c) The better responses provided the features and characteristics of both proteins and electrophoresis. Their answers were well structured with diagrams and headings to ensure that they addressed all parts of the question. Their judgement of the potential of electrophoresis as an analysis method was clearly defined.

(d) (i) Majority of candidates correctly identified the type of carbohydrate.

(ii) Most candidates could identify the distinguishing test. The better responses described the test and also provided the expected results including original colours as well as colours of the products ie the colour change.

(iii) Most candidates provided an answer in general terms rather than specifically to high performance liquid chromatography (HPLC). The better responses clearly outlined specific detail on HPLC including diagrams. These candidates provided a judgement on the effectiveness of the solvents used in separating the mixture of carbohydrates provided in the question, referring specifically to the information in the question.

Chemistry

2005 HSC Examination Mapping Grid

Question	Marks	Content	Syllabus outcomes
Section I Part A			
1	1	9.2.5 Column 2 dp 1	H6
2	1	9.2.2 Column 2 dp 4, 5	H9
3	1	9.2.3 Column 3 dp 6	H7, H9, H10, H12, H13
4	1	9.2.2 Column 2 dp 3	H9, H10, H14
5	1	9.2.4 Columns 3 dp 1 9.2.4 Column 2 dp 1, 2, 5	H7, H8, H14
6	1	9.3.5 Column 2 dp 7 9.3.5 Column 3 dp 2	H9
7	1	9.3.2 Column 2 dp 4, 5 9.3.2 Column 3 dp 1	H7, H8, H14
8	1	9.3.3 Column 2 dp 2, 5 9.3.3 Column 3 dp 7	H10, H12
9	1	9.3.4 Column 2 dp 9, 5 9.3.3 Column 2 dp 6, 7	H8
10	1	9.3.1 Column 2 dp 2 9.3.4 Column 2 dp 6, 7	H8, H10, H12
11	1	9.4.5 Column 2 dp 2	H6, H7, H12
12	1	9.1 H12.2 (b) H11.2 (c), (d) H12.4 (e), (f), 9.4.5.3.1	H11, H12
13	1	9.4.4 Column 2 dp 9	H9, H13
14	1	9.4.5 Column 2 dp 1, 2	H12, H14
15	1	9.4.5 Column 2 dp 1	H8, H10, H14
Section I Part B			
16 (a)	1	9.2.1 Column 3 dp 2	H9
16 (b)	2	9.2.1 Column 3 dp 2	H9, H12
16 (c)	2	9.2.1 Column 3 dp 2	H11
17 (a)	1	9.2.3 Column 3 dp 6 Column 2 dp 7	H7, H9
17 (b)	2	9.2.3 Column 3 dp 6 Column 2 dp 7	H7, H12, H14

Question	Marks	Content	Syllabus outcomes
18	4	9.2.2 Column 3 dp 1 Column 2 dp 1	H4, H9
19 (a)	1	9.2.4 Column 3 dp 3	H4, H7
19 (b)	3	9.2.4 Column 2 dp 4, 5, 6 Column 3 dp 3	H7, H8, H12, H13
20	7	9.2.3 Column 2 dp 5, 6 Column 3 dp 4, 5 9.3.5 Column 2 dp 2, 4, 5, 6 Column 3 dp 1	H8, H9, H11, H13, H14
21	5	9.3.4 Column 1, Column 2 dp 1, 2 Column 3 dp 1	H1, H6, H8
22 (a)	3	H12.3 (c)	H12, H13
22 (b)	2	9.3.2 Column 2 dp 9	H10, H12, H14
22 (c)	2	9.3.2 Column 2 dp 9	H10, H12, H14
23 (a)	1	9.4.1 Column 2 dp 3	H8
23 (b)	1	9.2.1 Column 3 dp 1 Column 2 dp 1	H8, H10, H13
24 (a)	1	9.2.1 Column 2 dp 1 9.2.1 Column 3 dp 1	H8, H10, H13
24 (b)	3	9.3.4 Column 3 dp 3	H10, H12, H13, H14
24 (c)	1	9.3.4 Column 3 dp 3	H10, H12, H13, H14
25 (a)	2	9.4.5 Column 3 dp 1 9.4.1	H2, H10, H14
25 (b)	2	9.4.3 Column 3 dp 1	H4, H8, H11
25 (c)	2	9.4.5 Column 3 dp 1 9.4.3 Column 3 dp 2	H3, H8, H11, H14
26	7	9.4.5 Column 3 dp 3 Column 2 dp 2, 3, 4	H3, H4, H8, H14
27 (a)	2	9.4.2 Column 2 dp 2, 3	H8, H12, H14
27 (b) (i)	2	9.4.2 Column 2 dp 3, 7, 9 9.3.2 Column 2 dp 4	H8, H10 , H13
27 (b) (ii)	2	9.4.2 Column 2 dp 3, 7, 9 9.3.2 Column 2 dp 4	H8, H10, H12, H14

Question	Marks	Content	Syllabus outcomes
Section II **Question 28 — Industrial Chemistry**			
28 (a) (i)	1	9.5.2.3.1, 9.5.3.2.3	H6, H10
28 (a) (ii)	3	9.5.3.2.7, 9.5.3.2.8, 9.5.3.3.3	H7, H8, H12, H14.1
28 (b) (i)	2	9.5.2.1, 9.5.2.2.1	H8, H10, H14
28 (b) (ii)	4	9.5.2.2.1, 9.5.2.2.2, 9.5.2.2.3, 9.5.2.3.3	H7, H8, H10, H12, H13, H14
28 (c)	7	9.5.4.2.2, 9.5.4.2.3, 9.5.4.3.2	H3, H7, H8, H10, H14
28 (d) (i)	1	9.5.6.2.1	H8, H10
28 (d) (ii)	2	9.5.6.2.3, 9.5.6.3.2	H8, H10, H13
28 (d) (iii)	5	9.5.6.2.1, 9.5.6.2.4, 9.5.6.3.3	H7, H8, H14
Section II **Question 29 — Shipwrecks, Corrosion and Conservation**			
29 (a) (i)	1	9.6.2.2.1	H6, H8
29 (a) (ii)	3	9.6.2.2.2, 9.6.2.2.3, 9.6.2.3.3	H6, H12, H13, H14
29 (b) (i)	2	9.6.5 (all)	H6, H8
29 (b) (ii)	4	9.6.2.2.4, 9.6.2.3.2, 9.6.4.2.2	H8, H10, H12, H13, H14
29 (c)	7	9.6.4.2.1, 9.6.4.2.3, 9.6.4.2.4, 9.6.4.3.3, 9.6.4.3.4	H3, H7, H8, H10, H14
29 (d) (i)	1	9.6.7.2.5, 9.6.7.3.1	H8, H14
29 (d) (ii)	2	9.6.7.2.1, 9.6.7.2.5, 9.6.7.3.1	H8, H14
29 (d) (iii)	5	9.6.7.2.1, 9.6.7.2.3, 9.6.7.2.4, 9.6.7.2.5, 9.6.7.3.1	H8, H10, H13, H14

Question	Marks	Content	Syllabus outcomes
Section II **Question 30 — The Biochemistry of movement**			
30 (a) (i)	1	9.7.3 Column 3 dp 1, 2	H9, H10, H13
30 (a) (ii)	3	9.7.3 Column 3 dp 2	H9, H14.1d
30 (b) (i)	2	9.7.7 Column 3 dp 1 9.7.1, 9.7.8 Column 2 dp 2	H7, H9, H12.4d, H14.1d
30 (b) (ii)	4	9.7.8 Column 3 dp 2 9.7.8 Column 2 dp 1, 2, 3, 4, 5	H7, H9, H12.4d, H13.1a, H14.1d
30 (c)	7	9.7.4 Column 2 dp 1, 2, 3, 4, 5, 7, 8 9.7.4 Column 3 dp 1, 3	H2, H9, H14
30 (d) (i)	1	9.7.2 Column 2 dp 1	H9, H10
30 (d) (ii)	2	9.7.2 Column 2 dp 2, 3 9.7.2 Column 3 dp 1	H7, H8, H9, H10
30 (d) (iii)	5	9.7.7 Column 1, 9.7.8 Column 1 9.7.10 Column 1	H7, H8, H9, H14.1a, H14.3c
Section II **Question 31 — The Chemistry of Art**			
31 (a) (i)	1	9.8.4 Column 2 dp 4	H8, H14.1d
31 (a) (ii)	3	9.8.4 Column 2 dp 3 9.8.4 Column 3 dp 3	H8, H10, H13.1d
31 (b) (i)	2	9.8.4 Column 2 dp 4 9.8.5 Column 2 dp 3, Column 3 dp 2	H6, H12.3c, H14.1b, H14.1h, H14.3b
31 (b) (ii)	4	9.8.1 Column 3 dp 1, 2 9.8.1 Column 2 dp 1, 2, 3, 7, 8	H1, H4, H8, H12.4d, e, H14.1a, e
31 (c)	7	9.8.2 Column 3 dp 3 9.8.2 Column 1, Column 2 dp 2, 8, 9	H3, H6, H14.1c
31 (d) (i)	1	9.8.3 Column 2 dp 1	H6
31 (d) (ii)	2	9.8.3 Column 2 dp 5, 7 9.8.3 Column 3 dp 1	H6, H7
31 (d) (iii)	4	9.8.3 Column 3 dp 1, 2 9.8.3 Column 2 dp 1, 2, 4, 5, 6, 7, 8	H6, H14.2a, H14.3a, b, d

Question	Marks	Content	Syllabus outcomes
Section II **Question 32 — Forensic Chemistry**			
32 (a) (i)	1	9.9.6 Column 2 dp 4, 5 9.9.6 Column 3 dp 2	H6, H12.3c, H14.1a
32 (a) (ii)	3	9.9.6 Column 2 dp 4, 5 9.9.6 Column 3 dp 2	H6
32 (b) (i)	1	9.9.4 Column 2 dp 1	H9, H10, H12.3c
32 (b) (ii)	2	9.9.4 Column 2 dp 2, 3	H4, H14.1g
32 (b) (iii)	3	9.9.4 Column 3 dp 1	H4, H14.3d
32 (c)	7	9.9.3 Column 2 dp 1, 2, 3, 4, 6 9.9.3 Column 3 dp 1, 5, 9.9.3.1	H9, H5, H14
32 (d) (i)	1	9.9.2 Column 2 dp 2	H9
32 (d) (ii)	2	9.9.2 Column 3 dp 2 9.9.2 Column 2 dp 1, 2, 3, 4	H9, H10
32 (d) (iii)	5	9.9.5 Column 2 dp 2 9.9.3 Column 2 dp 5 9.9.3 Column 3 dp 4	H9, H12.3c, H14.1a

BOARD OF STUDIES
NEW SOUTH WALES

2005 HSC Chemistry Marking Guidelines

Section I, Part B

Question 16 (a)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Correctly names an alkene that could realistically be used	1

Question 16 (b)

Outcomes assessed: H9, H12

MARKING GUIDELINES

Criteria	Marks
• Names a potential hazard related to the investigation • Provides main features of how the hazard was addressed	2
• Names a potential hazard related to the investigation OR • Correctly addresses a specific hazard related to the investigation	1

Question 16 (c)

Outcomes assessed: H11

MARKING GUIDELINES

Criteria	Marks
• Correctly outlines the procedure • Identifies an appropriate reagent • Identifies both appropriate organic substances • States use of small amounts	2
• Identifies an appropriate reagent OR • Correctly outlines procedure	1

Question 17 (a)

Outcomes assessed: H7, H9

MARKING GUIDELINES

Criteria	Marks
• States a correct reason	1

Question 17 (b)

Outcomes assessed: H7, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Calculates the correct mass of ethanol • Shows working	2
• Calculates the change in temperature correctly OR • Calculates the correct molar mass for ethanol OR • Correct substitution into formula	1

Question 18

Outcomes assessed: H4, H9

MARKING GUIDELINES

Criteria	Marks
• Names a recent development of a named biopolymer • States desirable properties of biopolymers • Identifies properties of biopolymers that allow an impact on society and environment • Makes a judgement about the impact of the biopolymer on both society and the environment	3–4
• Names a recent biopolymer • Identifies a property of a biopolymer that differentiates it from a synthetic polymer • States an impact on society or the environment	2
• Names a recent biopolymer OR • States a desirable property of a biopolymer (eg biodegradable) OR • States an impact on either society or the environment	1

Question 19 (a)

Outcomes assessed: H4, H7

MARKING GUIDELINES

Criteria	Marks
• Identifies one environmental impact	1

Question 19 (b)

Outcomes assessed: H7, H8, H12, H13

MARKING GUIDELINES

Criteria	Marks
• Identifies the composition of the anode, cathode and electrolyte • Provides two correct half-equations or one overall balanced equation	3
• Identifies the composition of the anode, cathode and electrolyte OR • Provides two correct half-equations or one overall balanced equation	2
• Identifies the composition of either the anode or cathode OR • Identifies the electrolyte	1

Question 20

Outcomes assessed: H8, H9, H11, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of the chemistry of fermentation and esterification • Includes two correct balanced chemical equations • Describes procedures in each of three steps including at least one diagram	6–7
• Provides characteristics and features of the chemistry and procedure in fermentation and esterification • Includes one correct chemical equation • Describes procedures in two steps including at least one diagram	4–5
• Provides characteristics and features of the chemistry and procedure in at least one step	2–3
• Identifies one aspect of the chemistry or procedure in one step	1

Question 21

Outcomes assessed: H1, H6, H8

MARKING GUIDELINES

Criteria	Marks
• Describes the correct chronological development of theory of acids • Draws out the implications of each development • Provides at least three definitions of acids • Indicates limitations of earlier definitions	4–5
• Outlines correct chronological development of theory of acids • Provides two definitions of acids and indicates a limitation of one definition	3
• Provides one definition of acids and indicates a limitation of that definition or implication of its development OR • States at least two definitions of an acid	2
• States one definition of an acid	1

Question 22 (a)

Outcomes assessed: H12, H13

MARKING GUIDELINES

Criteria	Marks
• Outlier plotted but not included in graph (line of best fit) • Intersection point indicated • Lines connecting data points are straight • Points plotted correctly • Axes labelled • Linear scales used on axes	3
• Points plotted correctly • Axes labelled with units • Linear scale used on axes	2
• Axes labelled • Linear scale used on axes OR • Points plotted correctly	1

Question 22 (b)

Outcomes assessed: H10, H12, H14

MARKING GUIDELINES

Criteria	Marks
• States correct value and provides appropriate supporting evidence including reference to HCl	2
• 380 mL, without explanation	1

Question 22 (c)

Outcomes assessed: H10, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Calculates volume of gas • Shows all relevant working	2
• Calculates moles of zinc OR • Writes correct balanced chemical equation OR • Provides an estimate of the volume of gas using the graph	1

Question 23 (a)

Outcomes assessed: H8

MARKING GUIDELINES

Criteria	Marks
• Identifies an appropriate circumstance	1

Question 23 (b)

Outcomes assessed: H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Writes a correctly balanced equation	1

Question 24 (a)

Outcomes assessed: H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Writes a correctly balanced equation • Includes states of matter	1

Question 24 (b)

Outcomes assessed: H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Correctly calculates the moles of hydrochloric acid	1

Question 24 (c)

Outcomes assessed: H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Calculates the mass of calcium carbonate and shows working and significant figures and units	3
• Provides some correct steps in the calculation	2
• Calculates moles of NaOH OR • Writes balanced equation for the reaction of NaOH with HCl or correct mole ratio OR • Calculates molar mass of calcium carbonate	1

Question 25 (a)

Outcomes assessed: H2, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Calculates the percentage of total dissolved solids in the sample	2
• Calculates the mass of total dissolved solids	1

Question 25 (b)

Outcomes assessed: H4, H8, H11

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of a test that could be used to identify lead ions in sample	2
• Names a correct reagent for identifying lead ions	1

Question 25 (c)

Outcomes assessed: H3, H8, H11, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a reason, with supporting argument, for monitoring a named ion	2
• States a reason for monitoring a named ion	1

Question 26

Outcomes assessed: H3, H4, H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of two possible sources of contamination • Describes at least three methods that could be used to purify the water • Provides a judgement about the effectiveness of each of the methods used or a holistic judgement with supporting statement	6–7
• Provides characteristics and features of two possible sources of contamination • Describes two methods that could be used to purify the water • Provides a judgement in general terms about the effectiveness of at least one method used	4–5
• Outlines at least one possible source of contamination • Describes at least one method that could be used to purify the water	2–3
• Identifies one possible source of contamination OR • Identifies one method that could be used to purify the water	1

Question 27 (a)

Outcomes assessed: H8, H12, H14

MARKING GUIDELINES

Criteria	Marks
• States that equilibrium has been reached	1

Question 27 (b) (i)

Outcomes assessed: H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Correctly sketches all three trends • Identifies that equilibrium is re-established	2
• All three trends shown correctly	1

Question 27 (b) (ii)

Outcomes assessed: H8, H10, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Outlines how Le Chatelier's principle is applied to trends in the graph • States effect in terms of relative number of moles of gas on either side	2
• States Le Chatelier's principle OR • States that equilibrium is disturbed	1

Section II

Question 28 (a) (i)

Outcomes assessed: H6, H10

MARKING GUIDELINES

Criteria	Marks
• Provides correct name	1

Question 28 (a) (ii)

Outcomes assessed: H7, H8, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of properties of both concentrated and dilute sulfuric acid • Relates properties of sulfuric acid to safety precautions necessary for its transport	3
• Relates a property of concentrated or dilute sulfuric acid to a safety precaution necessary for its transport	2
• States a property of sulfuric acid OR • States a safety precaution necessary	1

Question 28 (b) (i)

Outcomes assessed: H8, H10, H14

MARKING GUIDELINES

Criteria	Marks
• States the effect of the addition of a catalyst AND • States and gives reasons for the effect of an increase in pressure	2
• Correctly identifies the effect of the addition of a catalyst OR • Correctly identifies the effect of an increase in pressure	1

Question 28 (b) (ii)

Outcomes assessed: H7, H8, H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Calculates the equilibrium constant for the reaction correctly OR • Shows working towards the *K* value • Provides a reason for the difference in *K* value related to temperature	4
• Calculates the equilibrium constant OR correctly substitutes into equation • Makes a statement in general terms about the difference in *K* value related to temperature	2–3
• Correct equilibrium expression OR • Makes a correct statement for the difference in *K* values	1

Question 28 (c)

Outcomes assessed: H3, H7, H8, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Provides a description of the three methods used for NaOH production identifying the improvements in technology that have taken place • Provides advantages and disadvantages of methods • Includes relevant chemical equations	6–7
• Provides a description of two methods for NaOH production using equations • Identifies some improvements in technology that have taken place OR • Discusses advantages and disadvantages of three methods with no chemistry	4–5
• Outlines two methods of NaOH production OR • Describes one method of NaOH production OR • Outlines advantage and disadvantage of two methods	2–3
• Names a process of NaOH production OR • Provides a correct statement about production of sodium hydroxide	1

Question 28 (d) (i)

Outcomes assessed: H8, H10

MARKING GUIDELINES

Criteria	Marks
• Correctly identifies X	1

Question 28 (d) (ii)

Outcomes assessed: H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Provides main features of chemistry of ammonia recovery • States a valid reason for recovery	2
• Provides main features of chemistry of ammonia recovery OR • States a valid reason for recovery	1

Question 28 (d) (iii)

Outcomes assessed: H7, H8, H14

MARKING GUIDELINES

Criteria	Marks
• Names at least three environmental issues arising from the process • Describes methods of dealing with these issues • Makes a judgement on their effectiveness	4–5
• Names two environmental issues arising from the process • Identifies methods of dealing with these issues	2–3
• Identifies one environmental issue arising from the process OR • Identifies one method of dealing with these issues	1

Question 29 (a) (i)

Outcomes assessed: H6, H8

MARKING GUIDELINES

Criteria	Marks
• Correct answer provided	1

Question 29 (a) (ii)

Outcomes assessed: H6, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies similarities and/or differences in a specific property and states a use for each of two types of named steels	3
• States a property (and a use) for each of TWO named steels	2
• States a property for each of two named steels OR • States a use for each of two named steels OR • States a property and a use of one named steel	1

Question 29 (b) (i)

Outcomes assessed: H6, H8

MARKING GUIDELINES

Criteria	Marks
• Outlines one factor that influences rate of corrosion of iron in deep water wrecks	2
• Identifies one factor that influences rate of corrosion of iron in deep water wrecks	1

Question 29 (b) (ii)

Outcomes assessed: H8, H10, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of two chemical processes including experimental observations OR • Outlines three chemical processes AND provides two full balanced redox equations or equivalent half equations	4
• Provides characteristics and features of one chemical process including experimental observations • Provides a balanced redox equation or equivalent half equations OR • Outlines two correct chemical processes • Provides a full balanced redox equation or equivalent half equations	3
• Outlines one chemical process OR • Provides two full balanced equations or equivalent half equations	2
• Identifies a chemical process OR • Describes an observation OR • Provides a correct half equation or balanced full redox equation	1

Question 29 (c)

Outcomes assessed: H3, H7, H8, H10, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features three methods of corrosion protection • Relates advances in chemistry to the development of two of the three methods • Provides an advantage or disadvantage for all three methods • Includes relevant equations	6–7
• Provides characteristics and features two methods of corrosion protection (must include an equation) • Provides an advantage or disadvantage for each method	4–5
• Provides characteristics and features of one method of corrosion protection • Provides an advantage or disadvantage OR • Outlines two methods of corrosion protection • Provides one advantage or disadvantage	2–3
• Identifies a method of corrosion protection for ships OR • Makes a correct chemical statement about corrosion protection for ships	1

Question 29 (d) (i)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides valid reason for the use of wax	1

Question 29 (d) (ii)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Provides reason for using NaOH solution • Provides reason for regular replacement of NaOH solution	2
• Identifies purpose of NaOH solution OR • Provides a reason for regular replacement of NaOH solution	1

Question 29 (d) (iii)

Outcomes assessed: H8, H10, H14, H13

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of the procedure • Provides characteristics and features of the processes occurring at the cathode and anode • Provides appropriate equations • Provides at least one supporting argument for using the procedure described	4–5
• Outlines the procedure • Outlines the processes occurring at cathode or anode	2–3
• Provides one correct statement about procedure	1

Question 30 (a) (i)

Outcomes assessed: H9, H10, H13

MARKING GUIDELINES

Criteria	Marks
• Provides the correct structure	1

Question 30 (a) (ii)

Outcomes assessed: H9, H14

MARKING GUIDELINES

Criteria	Marks
• Provides reason for the viscosity of glycerol • Provides reason for the solubility of glycerol in water	3
• Provides reason for the viscosity of glycerol OR • Provides reason for the solubility of glycerol in water	2
• Identifies that glycerol is a polar molecule OR • Identifies that glycerol can form hydrogen bonds with other molecules	1

Question 30 (b) (i)

Outcomes assessed: H7, H9, H12, H14

MARKING GUIDELINES

Criteria	Marks
• States the energy output of both glycolysis and respiration	2
• States the energy output of either glycolysis or respiration OR • States that energy is stored in the form of ATP	1

Question 30 (b) (ii)

Outcomes assessed: H7, H9, H12, H13, H14

MARKING GUIDELINES

Criteria	Marks
• Provides characteristics and features of oxidation and reduction for respiration • Links the role of NAD^+/NADH and $FADH_2$/FAD to the production of ATP in respiration	3–4
• Outlines the role of oxidation and reduction in respiration (not all three parts) OR • Outlines the role of NAD^+/ NADH and/or FAD/$FADH_2$ in respiration	2
• Makes a correct statement about oxidation or reduction in respiration	1

Question 30 (c)

Outcomes assessed: H2, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Provides the relationship between the chemical features and the structure and shape of proteins • Describes the lock and key model of enzyme function • Provides a judgement about the importance of shape	6–7
• Provides the relationship between the chemical features and the structure and shape of proteins plus a judgement relating to shape • Describes the lock and key model of enzyme function and a judgement relating to shape	4–5
• Outlines how chemical features affect the structure and shape of proteins OR • Outlines the lock and key model of enzyme function	2–3
• Identifies one type of chemical feature that affects the structure or shape of proteins OR • Identifies that enzymes are catalysts OR • Identifies that proteins (or enzymes) are composed of amino acids	1

Question 30 (d) (i)

Outcomes assessed: H9, H10

MARKING GUIDELINES

Criteria	Marks
• Provides a correct definition	1

Question 30 (d) (ii)

Outcomes assessed: H7, H8, H9, H10

MARKING GUIDELINES

Criteria	Marks
• Identifies that carbohydrates are stored as glycogen • Provides the features of the condensation reaction involved in glycogen formation, including that the starting material is glucose	2
• Identifies that carbohydrates are stored as glycogen OR • Identifies that glycogen is formed from glucose OR • Identifies that the chemical process is a condensation reaction	1

Question 30 (d) (iii)

Outcomes assessed: H7, H8, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies that the sports drinks contain carbohydrates that can provide energy • Compares metabolic pathways used by sprinters and/or marathon runners • Provides an assessment of the value of the two sports drinks • Identifies that the sodium in the sports drink will not provide energy	4–5
• Describes metabolic pathways used by sprinters or marathon runners OR • Identifies that both sports drinks contain carbohydrates which can provide energy • Provides an assessment of the value of at least one of the two sports drinks	2–3
• Identifies that the sports drinks contain carbohydrates that can provide energy OR • Identifies that sodium will not provide energy OR • Identifies sodium being involved as electrolytic replacement	1

Question 31 (a) (i)

Outcomes assessed: H8, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies the observed colour change	1

Question 31 (a) (ii)

Outcomes assessed: H8, H10, H13

MARKING GUIDELINES

Criteria	Marks
• States reasons for changes in colour for both manganese and iron • Gives both correct half-equations	3
• States change in oxidation state for both manganese and iron and gives one correct half-equation OR • Gives both correct half-equations	2
• States change in oxidation state for either manganese or iron OR • Gives one correct half-equation OR • States that either manganese is reduced or iron is oxidised	1

Question 31 (b) (i)

Outcomes assessed: H6, H12, H14

MARKING GUIDELINES

Criteria	Marks
• States that colour of transition metal complexes depends on identity of metal ion and ligands • States that different oxidation states for the same metal exhibit different colours	2
• States that different oxidation states of transition metals exhibit different colours OR • States that colour depends on identity of metal ion and the surrounding ligands	1

Question 31 (b) (ii)

Outcomes assessed: H1, H4, H8, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of the use of minerals as pigments in two named ancient cultures • Provides a judgement of identified minerals/pigments in each of two named cultures	3–4
• Identifies two cultures and one mineral/pigment for each culture OR • Identifies one culture and at least two minerals/pigments	2
• Identifies two minerals/pigments used in ancient times OR • Identifies one mineral/pigment used by a culture	1

Question 31 (c)

Outcomes assessed: H3, H6, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of the methodology of laser microspectral analysis (LMA) • States one use of laser microspectral analysis (LMA) • Outlines an understanding of emission spectra formation • Provides a judgement on the types of technologies discussed	6–7
• Provides features and characteristics of the methodology of LMA • States one use of LMA • Provides a brief outline of emission spectra formation	4–5
• Outlines LMA • States one use of LMA • States one other technology or provides a brief outline of emission spectra formation	2–3
• Outlines emission spectra formation OR • Outlines one correct aspect of the methodology of LMA OR • States one use of LMA	1

Question 31 (d) (i)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Gives the correct definition	1

Question 31 (d) (ii)

Outcomes assessed: H6, H7

MARKING GUIDELINES

Criteria	Marks
• States the definition of the first ionisation energy • States the definition of electronegativity	2
• States definition of the first ionisation energy OR • States definition of electronegativity	1

Question 31 (d) (iii)

Outcomes assessed: H6, H14

MARKING GUIDELINES

Criteria	Marks
• Explains trend across period two for first ionisation energy • Explains trend down noble gases for first ionisation energy • Explains trend anomalies for B and O	4–5
• Explains the trend across period two for first ionisation energy • Explains the difference in first ionisation energy between helium and lithium AND explains either anomaly at B or O OR • Explains both of the anomalies at B or O	2–3
• States one trend related to the graph	1

Question 32 (a) (i)

Outcomes assessed: H6, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies the elements present in the sample	1

Question 32 (a) (ii)

Outcomes assessed: H6

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of emission spectra and their use in identifying the elements in a mixture	3
• Outlines the use of emission spectra in identifying the elements in a mixture	2
• Provides one statement about atomic emission spectroscopy	1

Question 32 (b) (i)

Outcomes assessed: H9, H10, H12

MARKING GUIDELINES

Criteria	Marks
• Identifies all the labelled components of DNA	1

Question 32 (b) (ii)

Outcomes assessed: H4, H14

MARKING GUIDELINES

Criteria	Marks
• Provides reasons why DNA analysis is used to identify related people	2
• Outlines DNA analysis	1

Question 32 (b) (iii)

Outcomes assessed: H4, H14

MARKING GUIDELINES

Criteria	Marks
• Identifies two or more points relating to DNA databanks and provides points for and against their use	3
• Identifies an issue and provides points for and against the use of DNA databanks OR • Describes two issues relating to DNA databanks	2
• Outlines an issue relating to DNA databanks	1

Question 32 (c)

Outcomes assessed: H5, H9, H14

MARKING GUIDELINES

Criteria	Marks
• Provides features and characteristics of the structure and composition of proteins • Describes the technique of electrophoresis using associated terminology • Provides a judgement about the effectiveness of electrophoresis	6–7
• Provides features and characteristics of the structure and composition of proteins • Outlines the technique of electrophoresis	4–5
• Outlines the technique of electrophoresis OR • Outlines the structure and composition of proteins	2–3
• Provides one statement about proteins or electrophoresis	1

Question 32 (d) (i)

Outcomes assessed: H9

MARKING GUIDELINES

Criteria	Marks
• Correct type of carbohydrate identified	1

Question 32 (d) (ii)

Outcomes assessed: H9, H10

MARKING GUIDELINES

Criteria	Marks
• Identifies a correct chemical test and the compound it identifies • Describes the observations	2
• Identifies a correct chemical test	1

Question 32 (d) (iii)

Outcomes assessed: H9, H12, H14

MARKING GUIDELINES

Criteria	Marks
• Provides the characteristics and features of high performance liquid chromatography (HPLC) • Makes a judgement about the effectiveness of the solvents	4–5
• Outlines HPLC • Makes a generalisation about the effectiveness of one solvent (A or B)	2–3
• Outlines a feature of HPLC OR • Makes a generalisation about the effectiveness of one solvent (A or B)	1